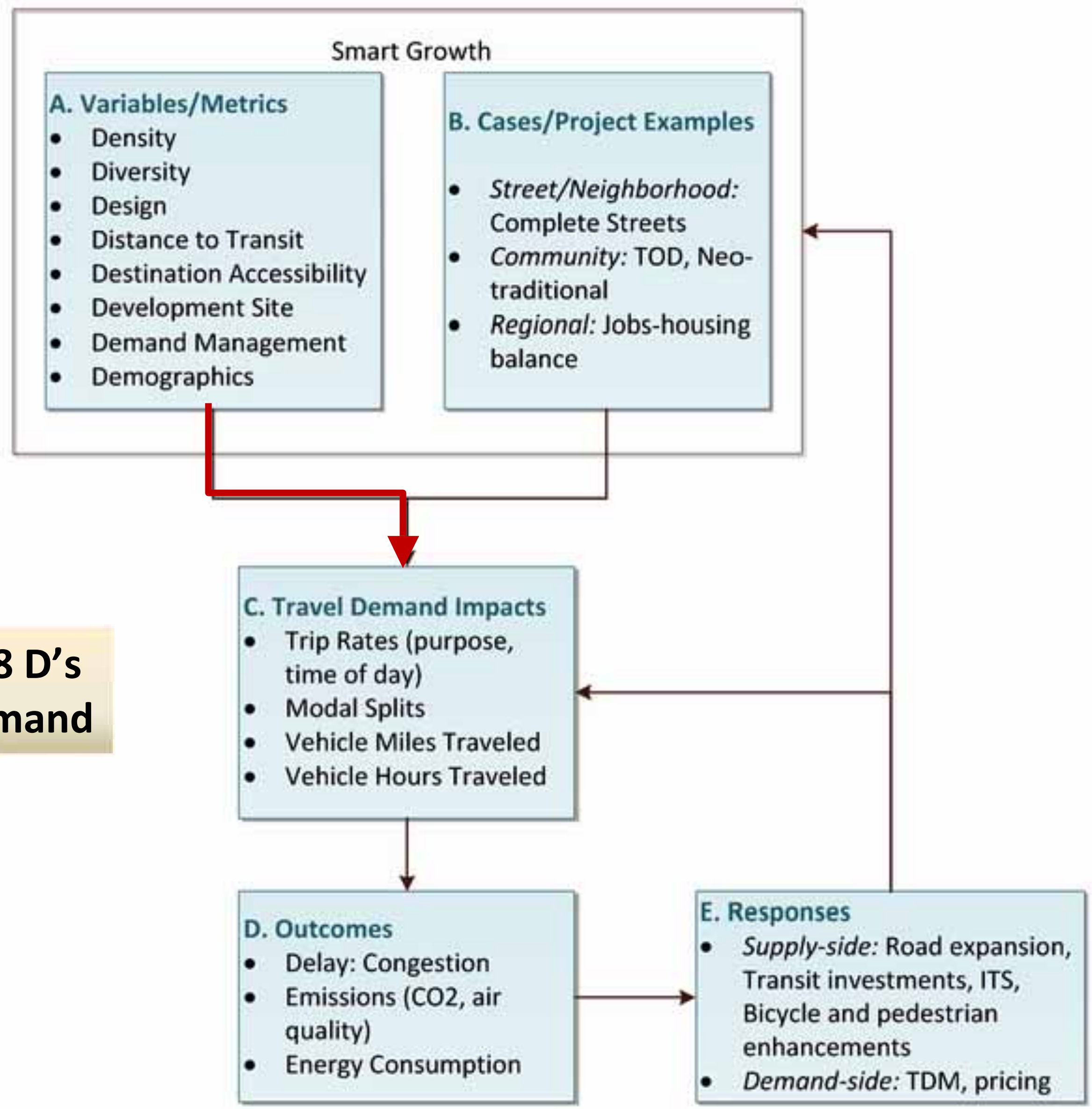
SmartGAP Framework: Incorporating Empirical Evidence

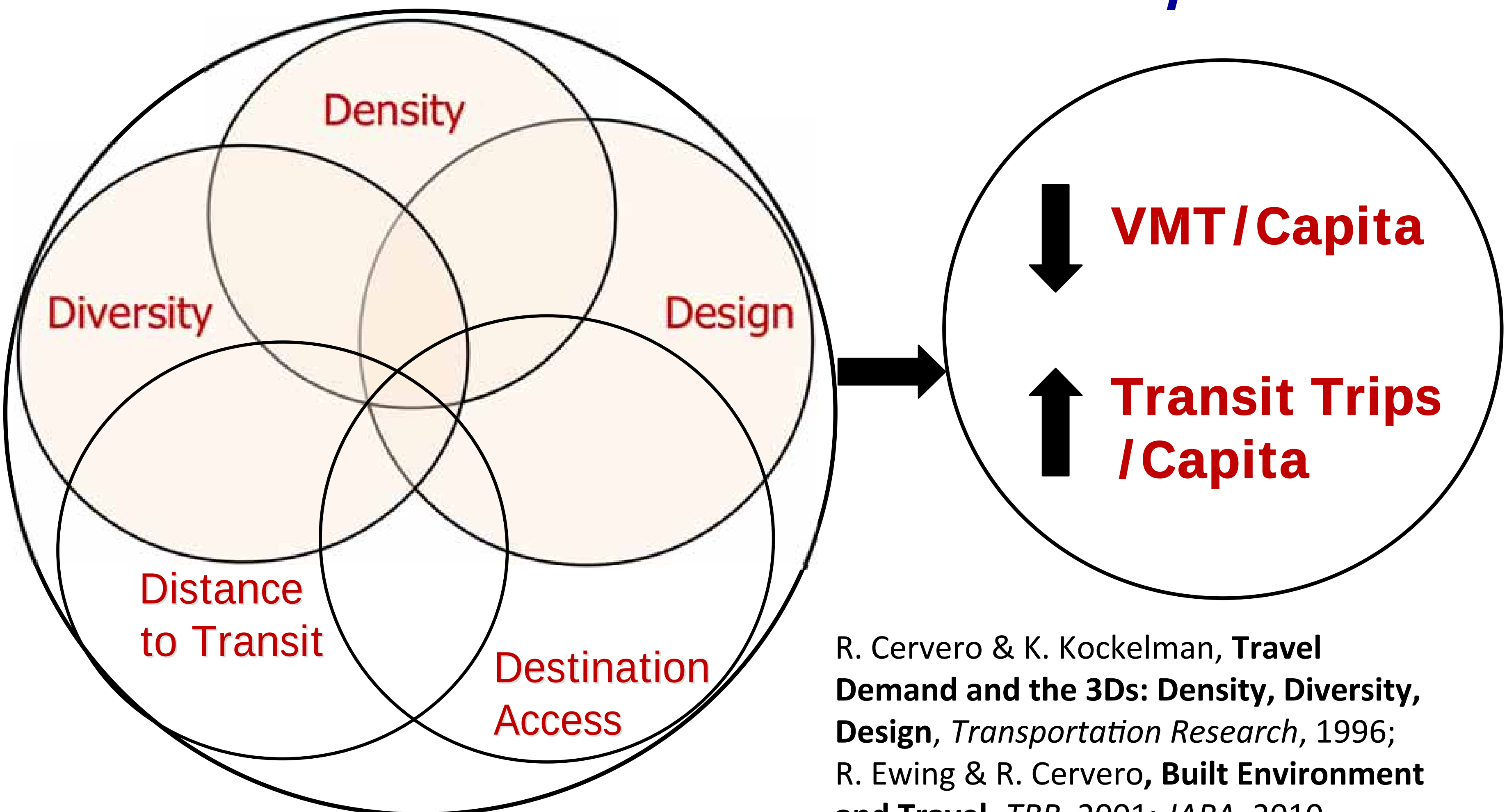


Translating 8 D's to Travel Demand

Travel & the "D"s

5D's of the Built Environment

Impacts



R. Cervero & K. Kockelman, **Travel Demand and the 3Ds: Density, Diversity, Design**, *Transportation Research*, 1996; R. Ewing & R. Cervero**, Built Environment and Travel,** *TRR,* 2001; *JAPA*, 2010

Meta-Evidence from Predictive Models

Vehicle Miles Traveled (VMT)

Elasticities from Regressions & Logits

Category	Urban Form Description	Elasticity for Change in VMT
Density	Household/Population Density	-0.04
Diversity	Land Use Mix (entropy)	-0.09
Design	Intersection/Street Density	-0.12
Destination Accessibility	Job Accessibility By Auto	-0.20
Distance to Transit	Distance to Nearest Transit Stop	-0.05

Source: R. Ewing & R. Cervero, Travel and the Built Environment: A Synthesis, *Transportation Research Record* 1780, 2001; Confirmed in Ewing & Cervero, *Journal of the American Planning Association* 2010.

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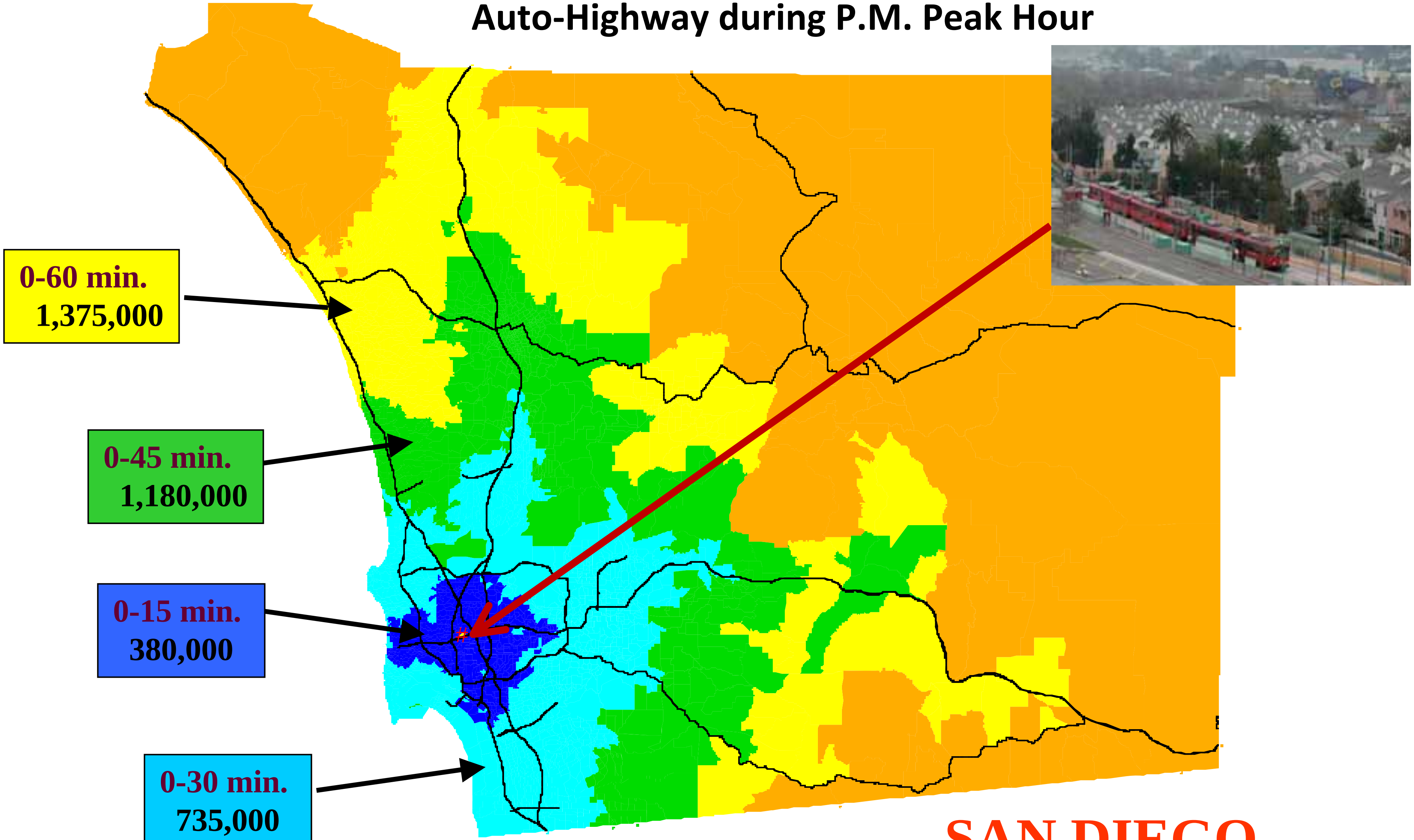
Elasticity = (% Δ Travel Demand) / (% Δ in Land Use)

Isochronic Measure of Job Accessibility for Mission Valley Tract

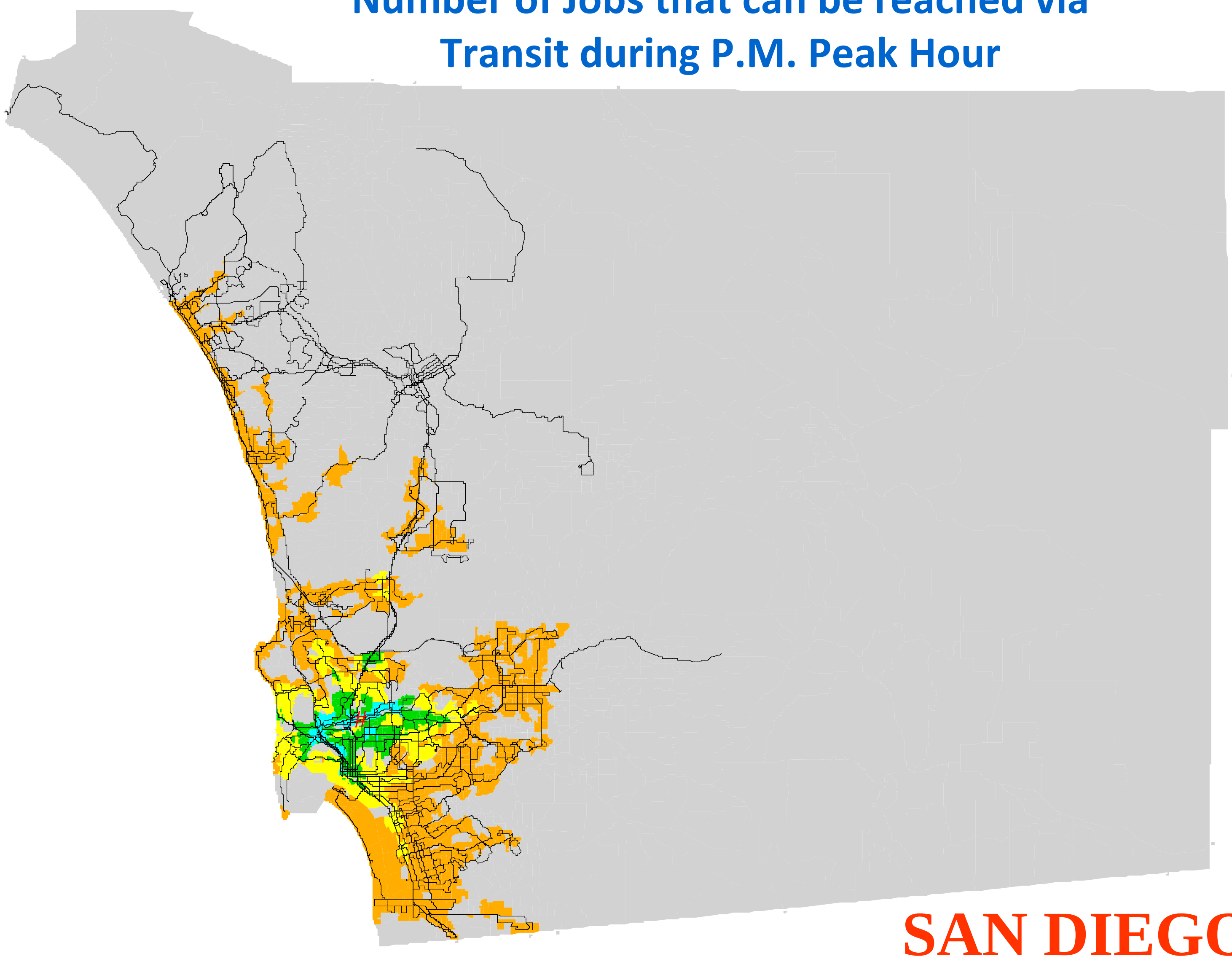
Number of Jobs that can be reached via Auto-Highway during P.M. Peak Hour



SAN DIEGO COUNTY

Isochronic Measure of Job Accessibility via Public Transit: Mission Valley, 2000

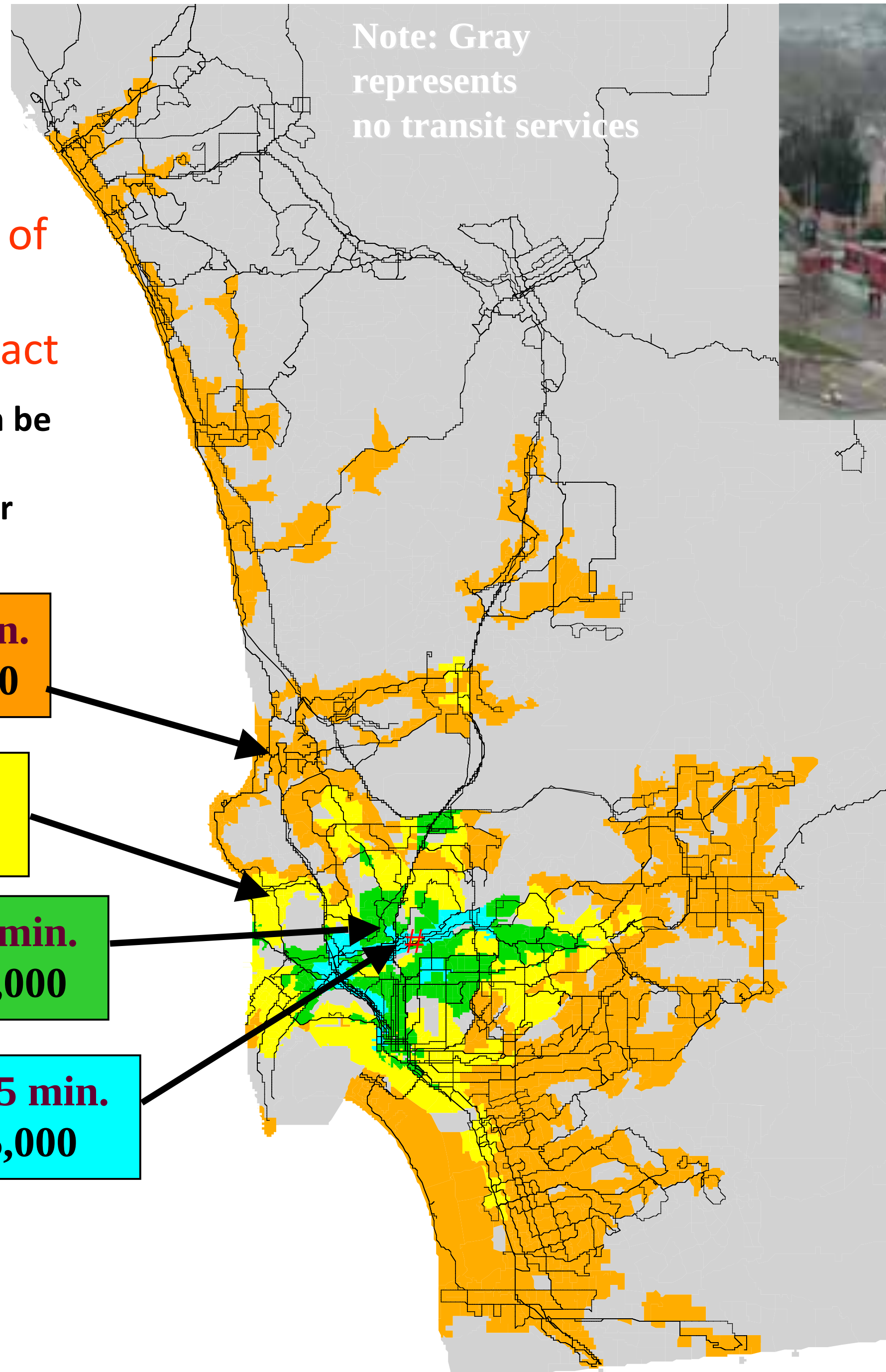
Number of Jobs that can be reached via Transit during P.M. Peak Hour



SAN DIEGO COUNTY

Isochronic Measure of Job Accessibility for Mission Valley Tract

Number of Jobs that can be reached via Transit during P.M. Peak Hour



0-60 min.
340,000

0-45 min.
285,000

0-30 min.
170,000

0-15 min.
75,000

Automobility's Accessibility Advantage
Mission Valley, 2000

Time Isochrone	A.I. Auto	A.I. Transit	Accessibility Advantage: Auto to Transit
0-15 Min.	380,000	75,000	5.13
0-30 Min.	735,000	170,000	4.32
0-45 Min.	1,180,000	280,000	4.21
0-60 Min.	1,375,000	340,000	4.04

Meta-Evidence from Predictive Models

Transit Ridership

Elasticities from Regressions & Logits

Dimension	Metric	# Studies	Elasticity
Density	**Population Density**	**10**	**.07**
	Job Density	**6**	**.01**
Diversity	**Land Use Mix** (0-1)	**6**	**.12**
Design	**Intersections/Street Density**	**4**	**.23**
	Connectivity (4-way inter.)	**5**	**.21**
Distance to Transit	**Distance**	**3**	**.29**

Source: R. Ewing & R. Cervero, Travel and the Built Environment: A Meta-Analysis, *Journal of the American Planning Association* 2010.

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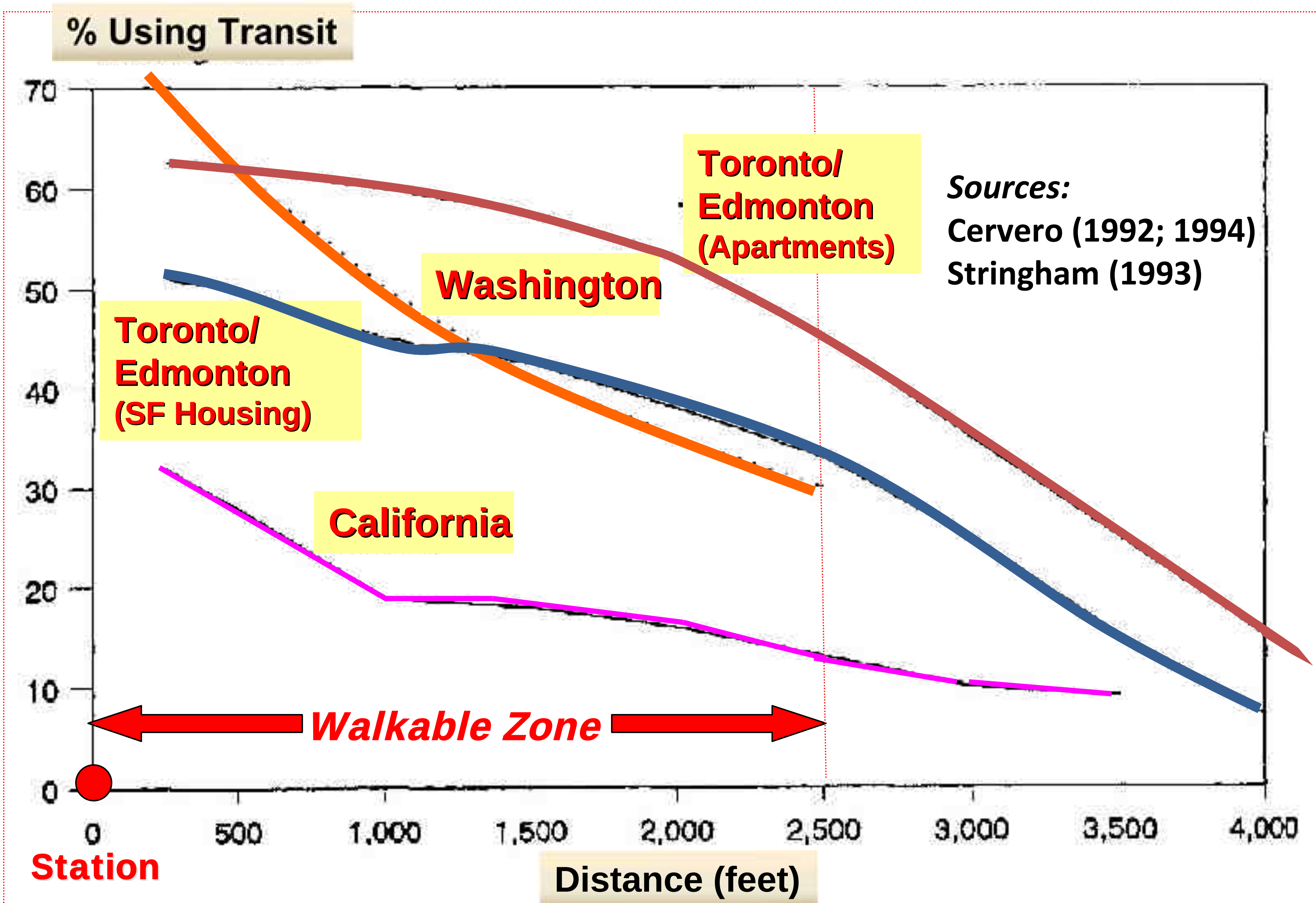
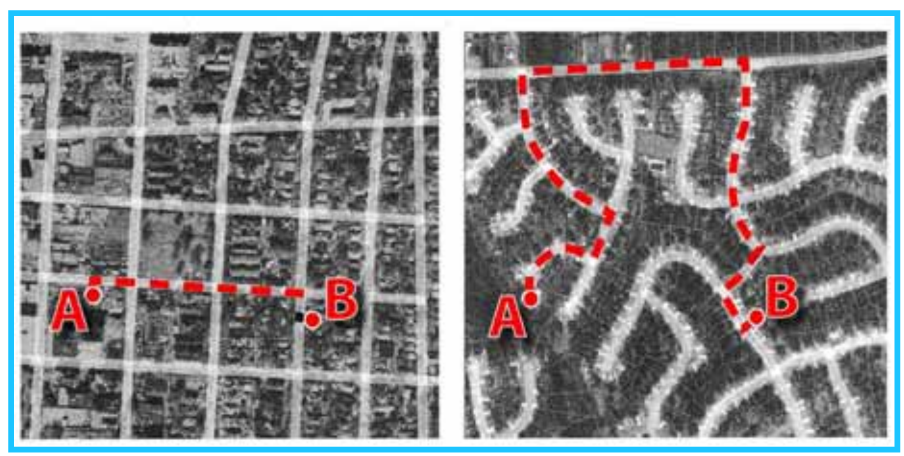
Elasticity = (% Δ Ridership) / (% Δ in "D" Variable)

DISTANCE TO RAIL TRANSIT



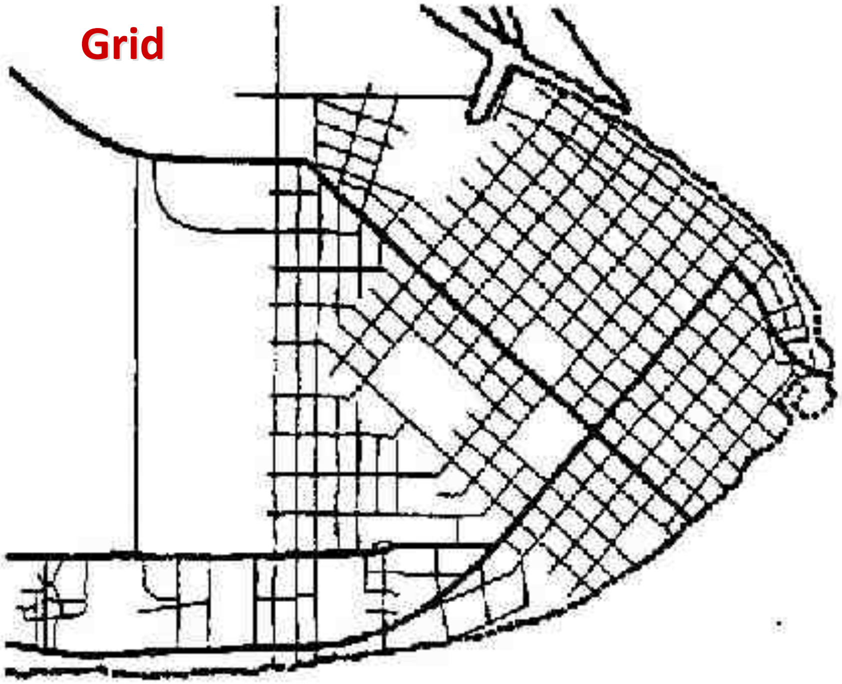
Walkability Elasticities

Variable	Description	Walking Increase
Density	Household/Population Density	0.07
Diversity	Land Use Mix (entropy)	0.15
Design	Intersection/Street Density/Connectivity	0.39
Destination Accessibility	Job Accessibility By Auto	0
Distance to Transit	Distance to Nearest Transit Stop	0.15



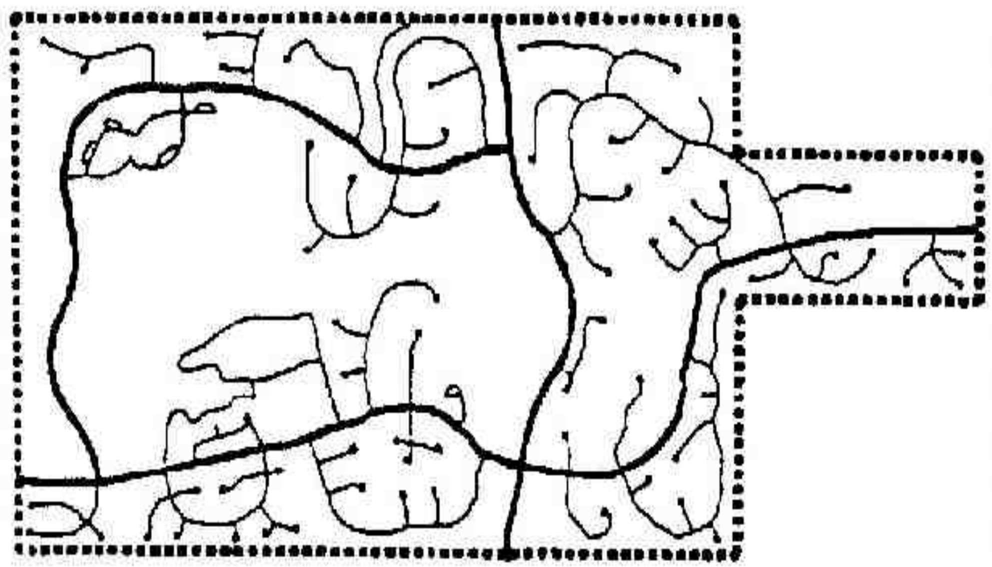
Roadway Designs/Configurations

Grid



Connectivity Index = 1.7

Curvilinear: Loops & Lollipops



Connectivity Index = 1.2

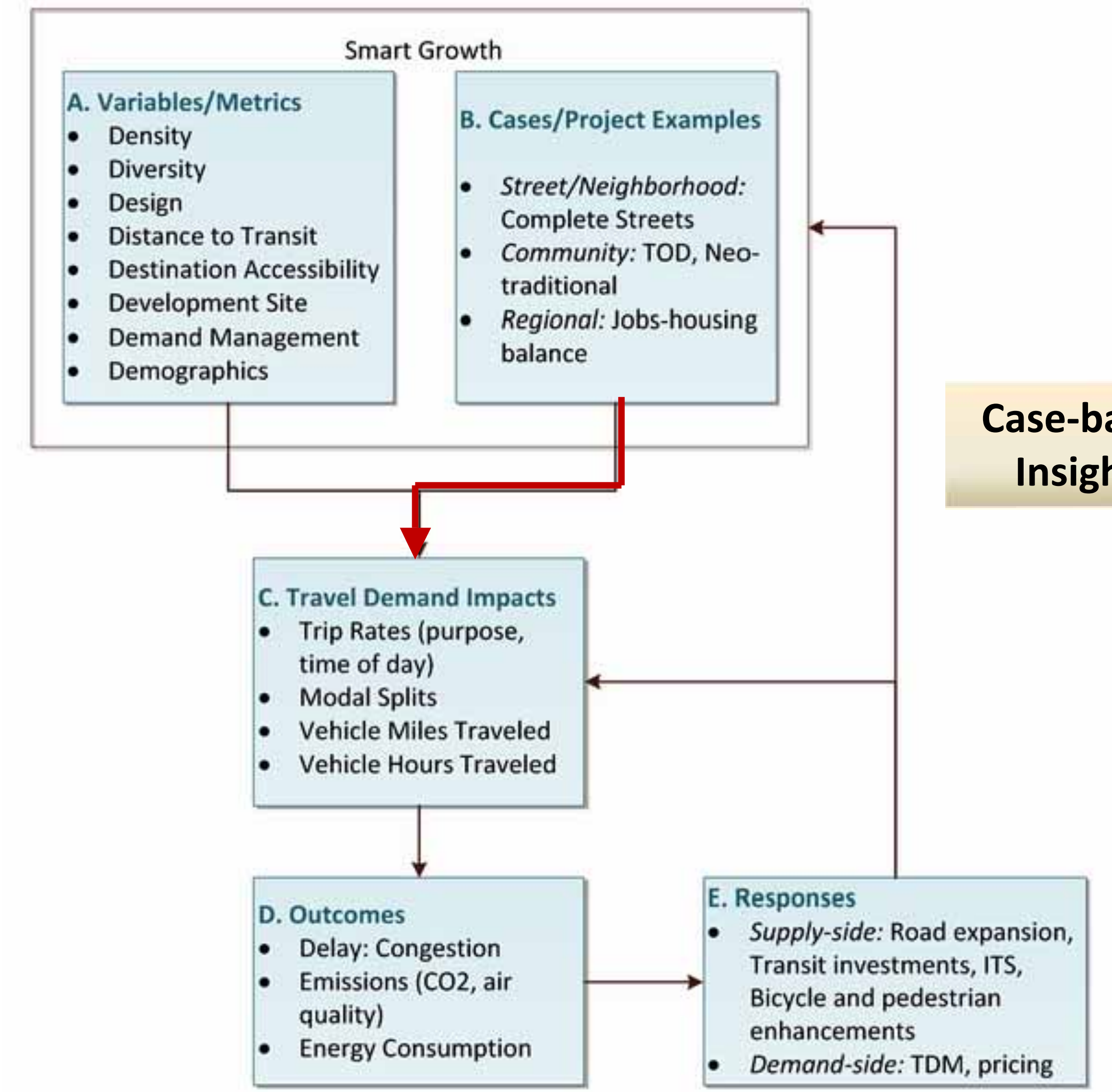
Network Connectivity Index = (# Roadway Links) / (# Nodes)

Elasticity = (% Δ Walking) / (% Δ in "D" Variable)

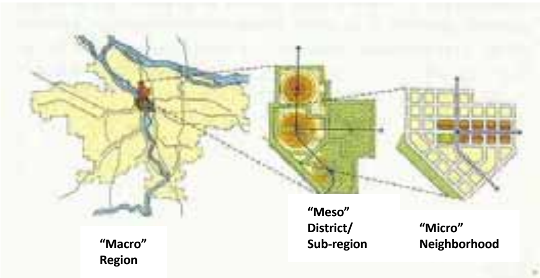
% Δ Walking = **Elasticity** * (% Δ in "D" Variable)

% Δ Walking = **0.39** * (1.7/1.2) = **55%**

Grounding SmartGAP: Incorporating Empirical Evidence



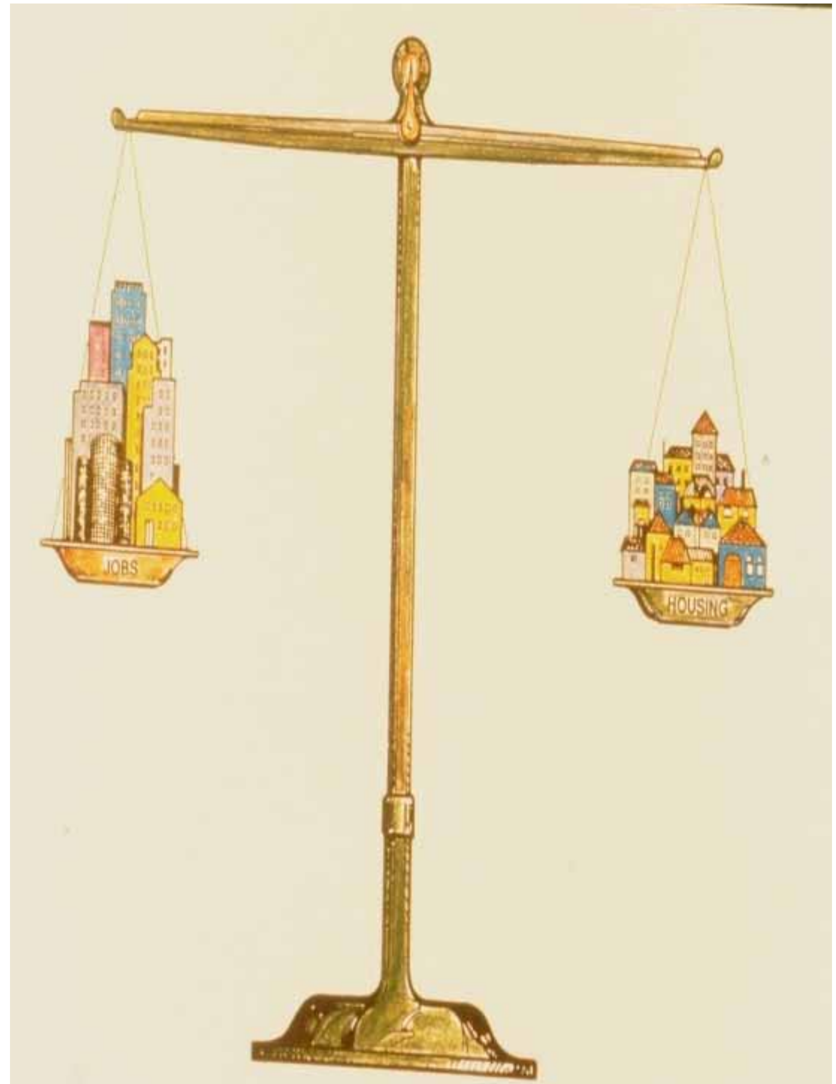
Case-based Insights



Geographic Scales	Settings/Place Types			
	Urban Centers	Close-in Compact Communities	Suburban	Rural/Exurban
Macro/ Regional	▪ Adaptive Reuse/Infill/ Redevelopment	▪ Mixed-Use Development/Activity Center ▪ Adaptive Reuse/Infill/Redevelopment Job-Housing Balance	▪ Mixed-Use Development/ Activity Center ▪ Adaptive Reuse/Infill/ Redevelopment Job-Housing Balance	▪ Telecommunities ▪ Mixed-Use Development/ Activity Center or ▪ Traditional rural township
Meso: subregional/ corridor	▪ Job-Housing Balance ▪ Transit Oriented Corridor	▪ Transit Oriented Corridor ▪ Job-Housing Balance	▪ Transit Oriented Corridor ▪ Job-Housing Balance ▪ Mixed-Use Development/ Activity Center	▪ Telecommunities ▪ Mixed-Use Development/ Activity Center or ▪ Traditional rural township
Micro: neighborhood/ community	▪ Transit Oriented Development	▪ Transit Oriented Development ▪ Traditional Neighborhood Design/New Urbanism (residential focus)	▪ Transit Oriented Development ▪ Traditional Neighborhood Design/New Urbanism (residential focus)	▪ Telecommunities

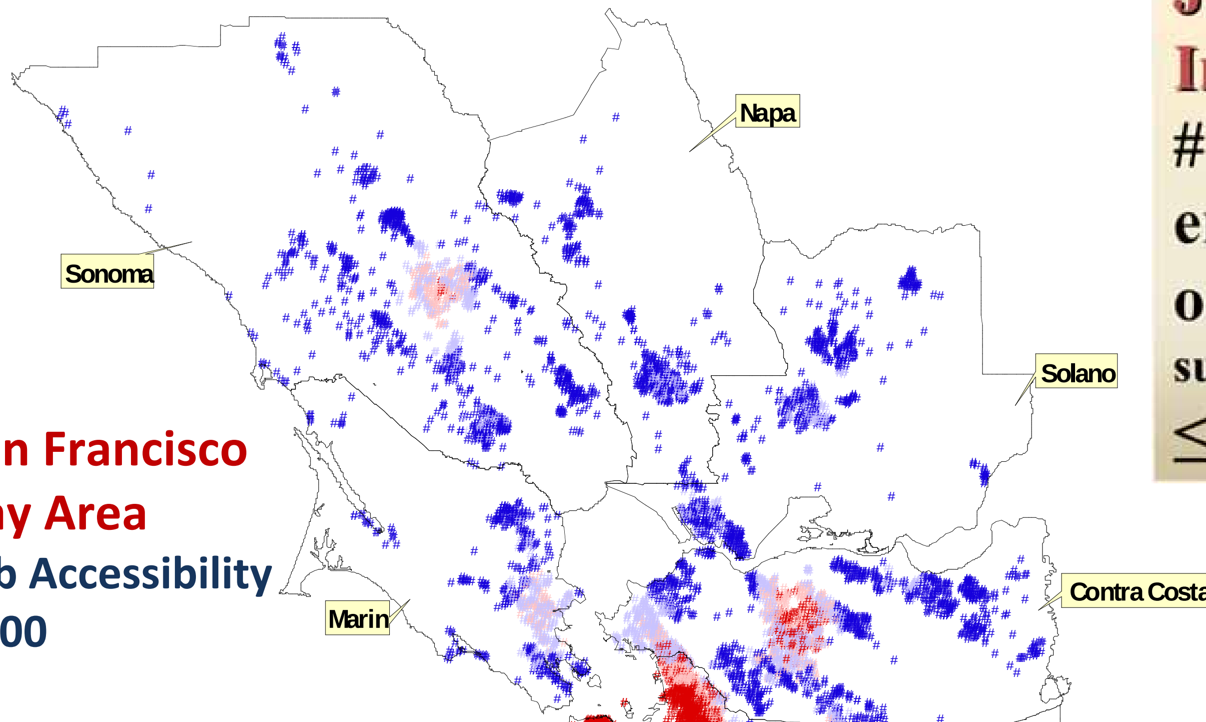
Balanced Regional Growth

- ***AIMS:***
  - *Reduce VMT*
  - *Rationalize Travelsheds*
  - *Protect & Conserve Land*
  - *Reduce travel costs/ increase housing affordability (location efficiency)*

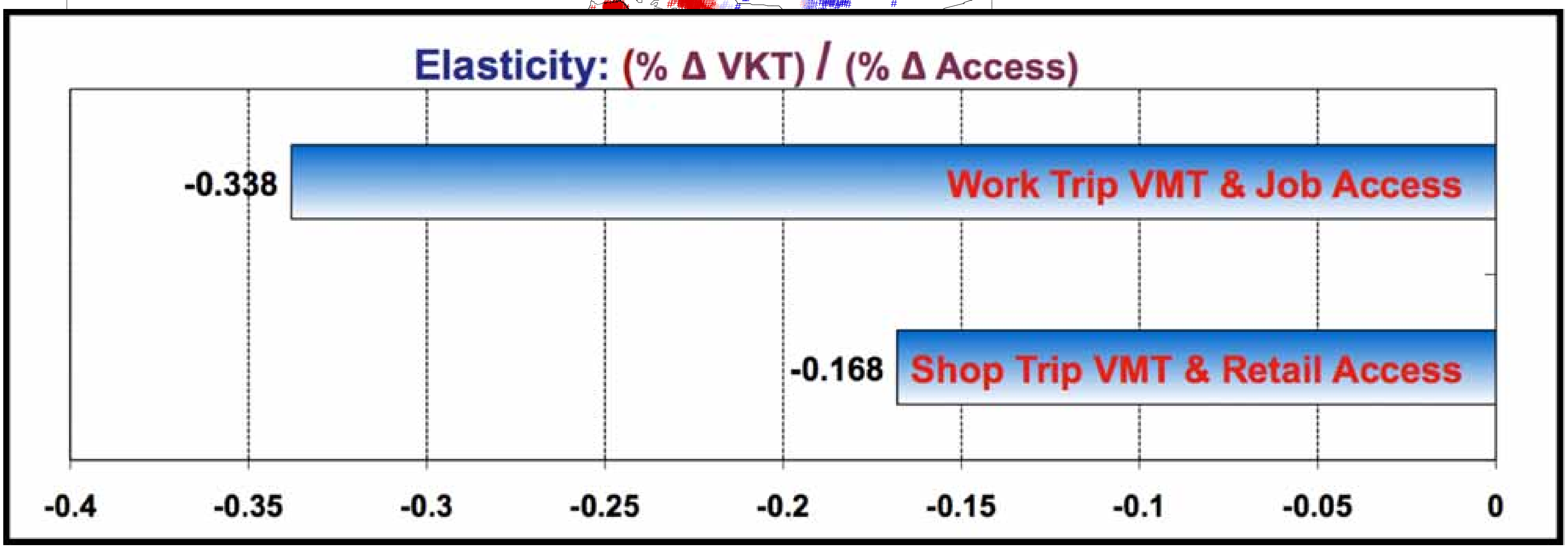


San Francisco Bay Area

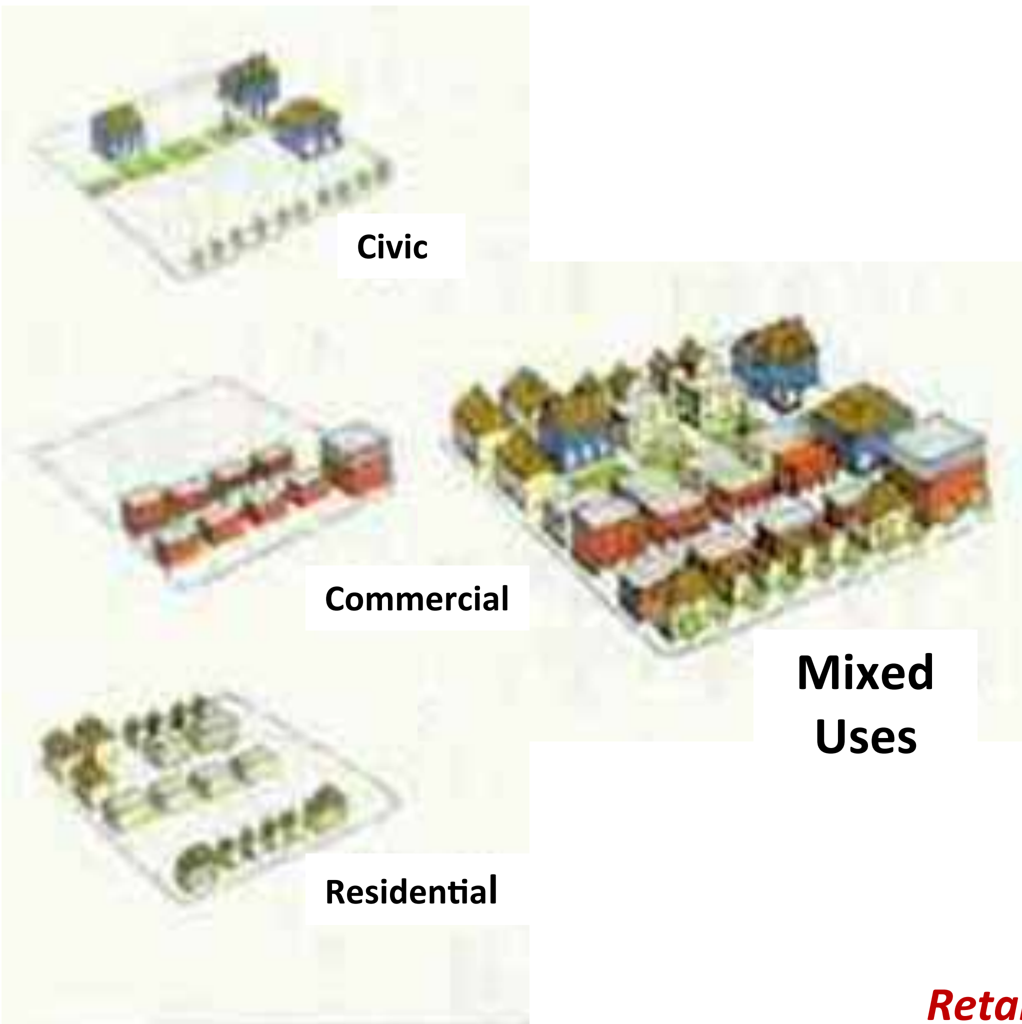
Job Accessibility 2000



Jobs Accessibility Index (OM) =
# of jobs in employed-resident's occupation (exec/prof; support/service; blue collar) ≤ 4 miles

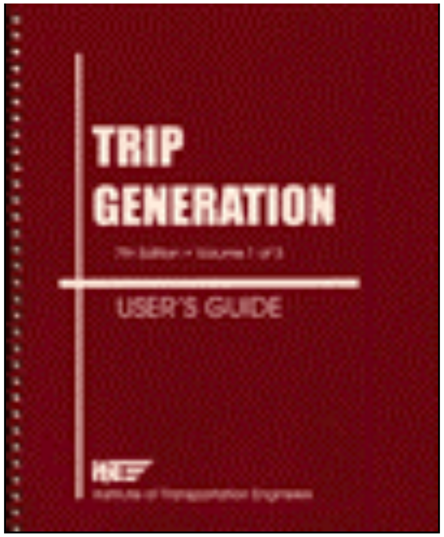


Mixing Uses at Activity Centers



Thornton Place, Northgate Mall, North Seattle, WA

Retail – Housing – Offices: Live, Work, Shop, Play



Recommend 20% to 25% "Internal Capture" adjustments to ITE Trip Generation Rates for Mixed-Use Activity Centers

R. Ewing, et al. 2011. Traffic Generated by Mixed-Use Developments. *Journal of Urban Planning and Development*.

MXDs generate far less traffic than single-use suburban development

Experiences of 6 large-scale US Suburban MXDs:

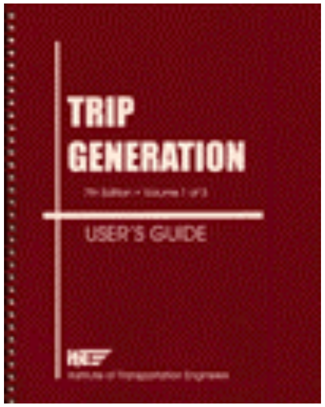
- **30% Internal Capture**
- **15% of External Trips by foot, bike, transit**
- **45% of trips put no strain on external road network**

Transit Oriented Development (TOD)

- Compact
- Mixed Land Uses
- Pedestrian-friendly design
- Physically “oriented” to transit; not just “adjacent”

Transit Station & Environs – “A Place to Be…
Not Just to Pass Through”

TOD's Ridership Bonus: In U.S., a product of self-selection



ITE Trip Manual

6.72 vehicle trips per apartment unit

TODs generate 50% less traffic than predicted

17 Residential TODs

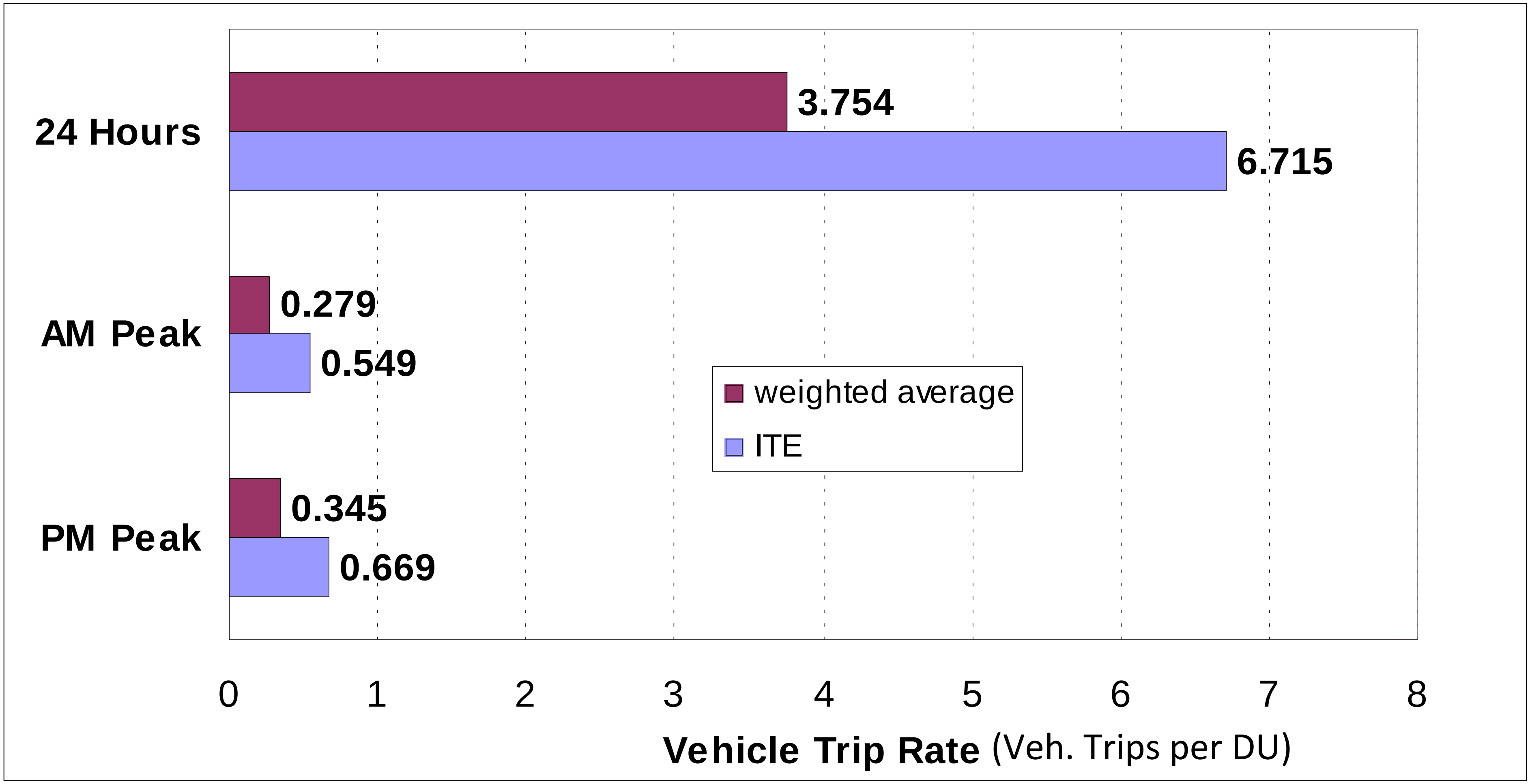
3.75 vehicle trips per unit

Source: TCRP H-27A Study, based on counts in Washington, DC; San Francisco Bay Area; Metro Portland, OR; and Philadelphia / N.E. New Jersey

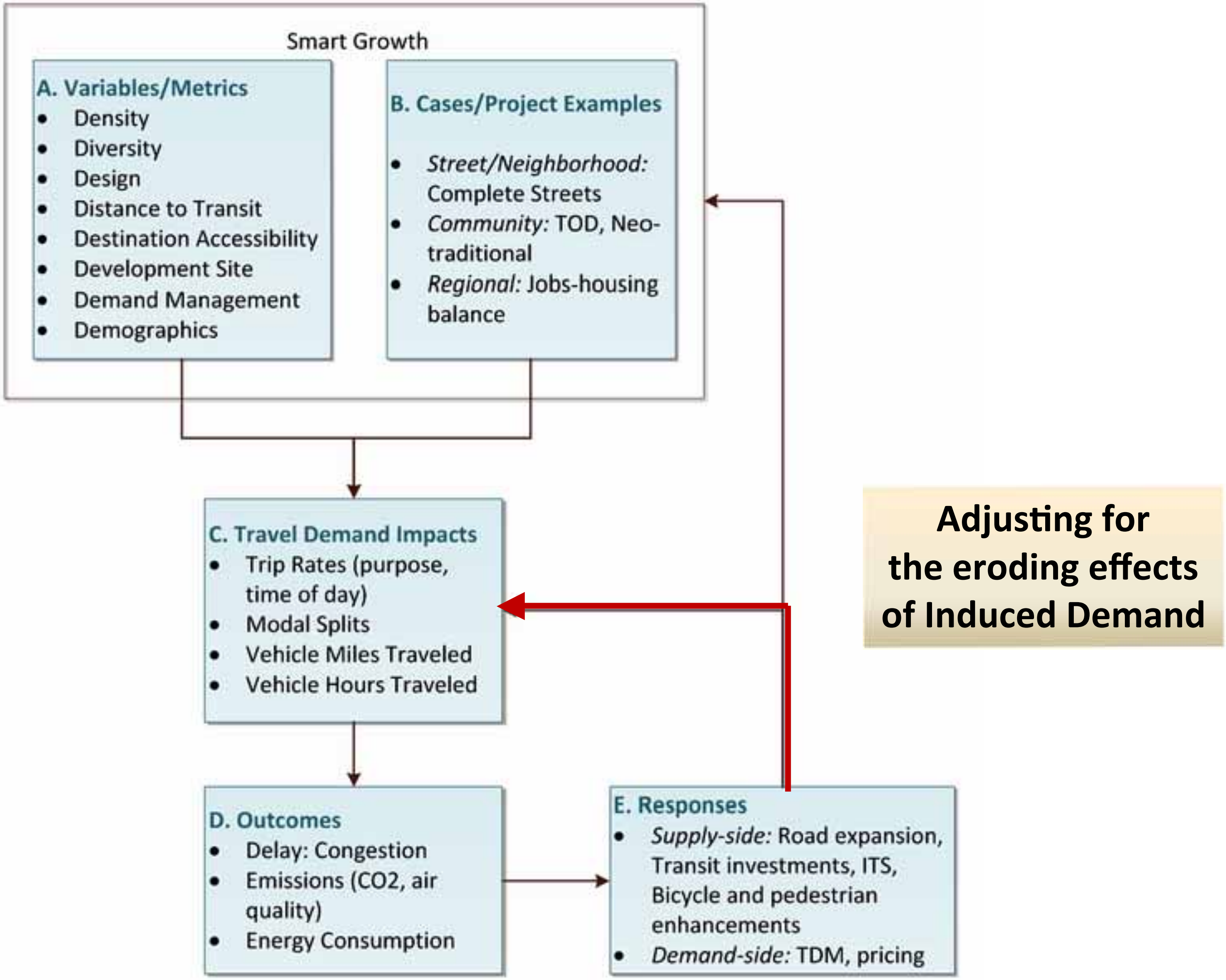
Average Difference Between TOD Rates & ITE Rates for all Projects

Less by:

- 44% all day
- 49% AM Peak
- 48% PM Peak



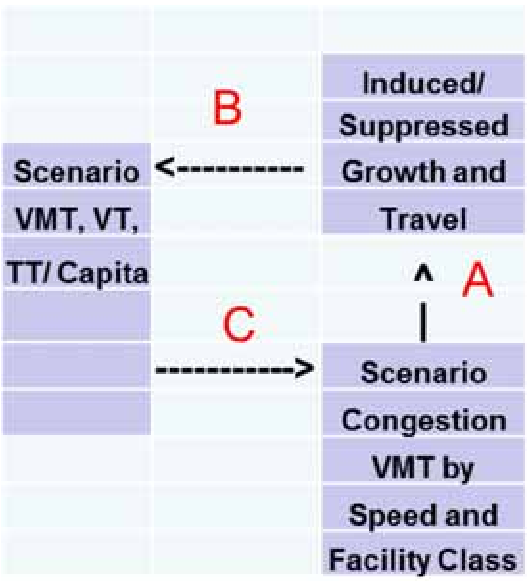
Grounding SmartGAP: Incorporating Empirical Evidence



Induced Travel Demand

- **Inputs for Software Tool: Road Expansion Scenario**

Primary Source:
Path Model 2002



A: **Supply-side improvement, like road expansion**

B: **Induced travel**

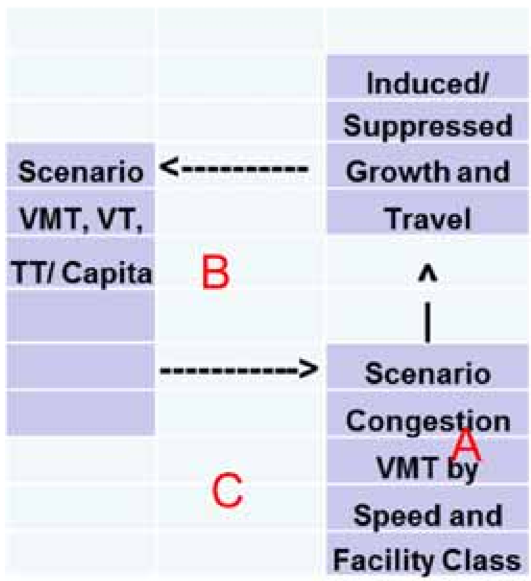
- *Near Term:* Latent demand; mode & route shifts; longer trips
  [*VMT Elasticity (function of speed)* = +0.40]
- *Long Term:* Adds structural shifts, including induced growth and car ownership
  [*VMT Elasticity (function of speed) = +0.73*]

C: **Scenario adjustment** by user accounting for induced travel impacts

Induced Travel Demand

•Inputs for Software Tool: Smart-Growth Scenario

Primary Source:
Path Model 2002



A: **Smart-growth scenario, like TOD**

B: **Induced travel:**

- *Near Term:* Minimal
- *Long Term:* Some evidence of travel-inducing effects of lowering travel costs, such as with mixed-use development, but evidence is limited;
- No adjustments for possible VMT-eroding impacts because of limited empirical evidence

C: **Scenario adjustment** at user discretion to account for possible second-order induced travel impacts

Study of MXD in Texas (Sperry et al., 2010):

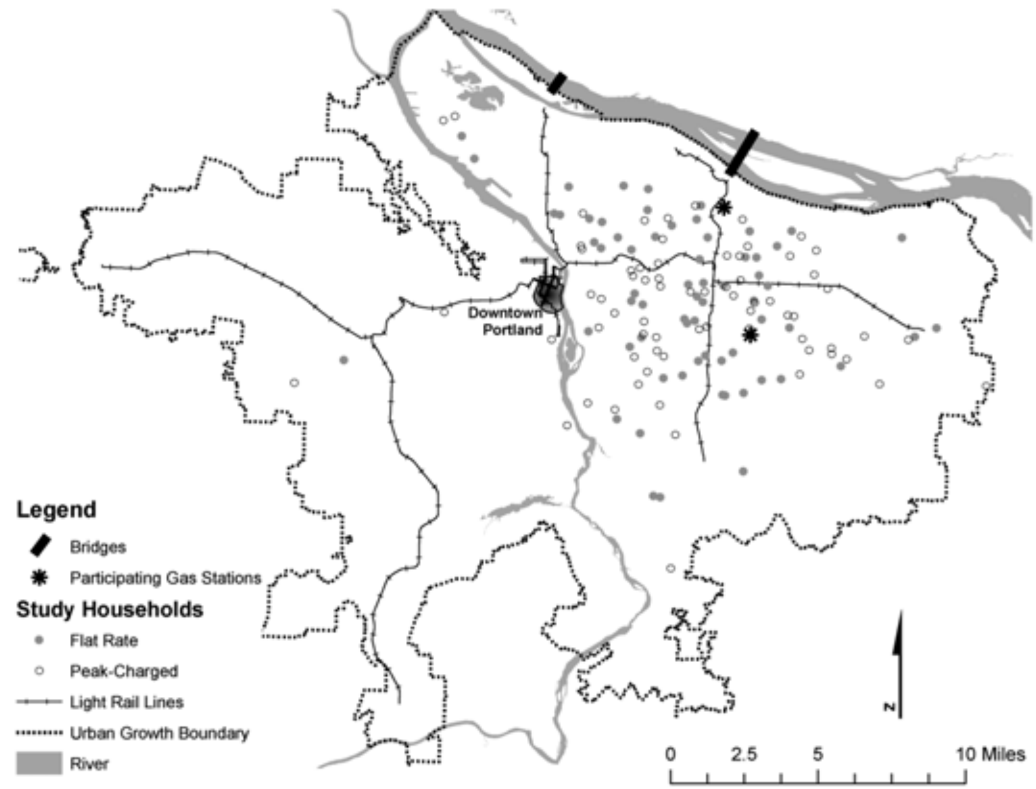
- **~ ¼ of survey respondents making trips in MXD wouldn't travel if trip were external**
- **Estimated 17% of internal car trips were induced**

Interactive Effects? TOD & TDM

- **2006 Experiment of VMT Charge in Portland OR**

- **183 HHs** – some paid flat VMT rate; others paid rate that varied by time and location – **10¢/mile peak; 0.5¢/mile off-peak (congestion charge)**

- Found **greater VMT reduction** in **denser, mixed-use neighborhoods with congestion charges**



Are Land Use Planning and Congestion Pricing Mutually Supportive? Evidence From a Pilot Mileage Fee Program in Portland, OR
Zhan Guo, Asha Weinstein Agrawal, and Jennifer Dill
Journal of the American Planning Association, Vol. 77, No. 3, Summer 2011

Arlington County

America's Success Story
TOC: Transit Oriented Corridor
"String of Pearls"

- VMT/capita of TOD Residents: 40% below regional average
- "Balanced Development" = "Balanced Flows"